

Welcome to SCH3U

Introductions: Teacher: Mrs. Neman
OFFICE: Math (3rd floor, #20080)/
Science (2nd floor, #20095)
416-395-3290

Course Prerequisite: SNC2D

Student Information Survey:

- Tell me about yourself

Text: McGrawHill Ryerson, Chemistry 11

Course Logistics

- *What is the course about? What topics will be covered?*

Strands of Study (Units)	Number of Lessons
Matter, Chemical Trends and Chemical Bonding	15
Chemical Reactions	15
Quantities in Chemical Reactions	17
Solutions and Solubility	20
Gases and Atmospheric Chemistry	14

Missed Evaluations

- How will missed or incomplete evaluations impact my grade?
- **Zero: Earned vs. placeholder**
- Absences for an evaluation will result in a mark of **ZERO** unless arrangements have been made with your teacher prior to the evaluation.
- **Do NOT expect to show up the next day with a note of any kind and be able to write the test/quiz.**
- Projects/assignments are due on the given due dates. If there are difficulties, discuss these issues with your teacher as soon as possible. This must be **BEFORE** the due date if any accommodations are to be made. Otherwise a mark of zero will be earned.
- Leaving early for a family vacation will not be considered a legitimate excuse for missing evaluations.

Keys to Your Success

•Your achievement in Learning Skills (independent work, teamwork, organizational skills, initiative and work habits) is key to your success.

•Academic integrity, good attendance, homework, PARTICIPATION and homework and assignment completion are critical.

•Respect yourself and other's.

•SAFETY in the Lab!

STUDENTS WHO ARE SUCCESSFUL IN SCIENCE REGULARLY:

- **USE CLASS TIME EFFECTIVELY**
- **Use a homework study buddy**
- **ASK QUESTIONS IN CLASS**
- **USE THE TEXTBOOK**
- **REVIEW EVERY DAY**
- **COME IN FOR EXTRA HELP**

Assessment & EVALUATION

quizzes, tests, problem-sets, laboratory activities, hands-on activities, independent study, problem-based learning, role-plays, and simulations.

Term Evaluation			
70 %	Knowledge/ Understanding 21%	Inquiry 21%	Communication 14% Making Connections 14%
Final Evaluation			
30 %	Exam		

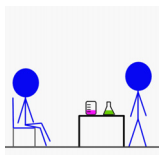
Ice Breaker

• Chemistry Magic Box:

- Put the number of the definition from the list below into the space. Check your answers by adding the numbers to see if all the sums of all rows, both across and down add up to the same number, the Magic Number
- If you finish, try the chemistry story (on the back of the sheet)

What is Chemistry

- Chemistry**: the study of matter and energy and the interactions between them.



Why Study Chemistry?

- The chemical industry is one of the most important industries in the world.

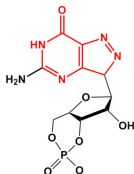
• The chemical industry is important for many reasons:

- In Ontario, the chemical industry has employed over **50 000** people (creates jobs) and produced products worth over \$22 billion.
- The chemical industry is responsible for the production of **plastic** which we use every where in our everyday life (bottles, parts of cars, parts of TVs, pencils, walls, clothing have plastic fibres, cell phones).



Chemistry is responsible for solving several societal issues

- Environmental Issues:** Preventing release of dangerous toxins from manufacturing sites, preventing corrosion (rust) on buildings and important monuments.
- Health Issues:** Developing drugs to fight dangerous diseases, developing lifestyle drugs (ex: Viagra).
- Many diseases occur because of altered chemistry in your body. If we understand this chemistry we are in a better position to fix it should anything go wrong with it.



Chemistry and Aspartame

- Aspartame was discovered in 1965 by James M. Schlatter. Schlatter had synthesized aspartame in the course of producing an antilucer drug candidate. He accidentally discovered its sweet taste when he licked his finger, which had become contaminated with aspartame, to lift up a piece of paper.



Chemistry is Everywhere

- When you cook, you are performing chemistry.
- Chemistry is occurring in you as we speak.
- When you recharge a battery, you are using chemistry.
- When you light a candle, you are using chemistry.
- When you freeze water, you are using chemistry... The list goes on and on...and on...and on...



ABC'S of Chemistry

- Everyone comes up and puts 2-3 related chemistry concepts
- It must be related to chemistry (i.e. element and properties, chemical reactions, etc..)
- If something is already on the board, you must put something else on!

Tomorrow....

Please bring:

- 1) Calculator (scientific)
- 2) Signed Safety Contract

We will begin:

Unit 1: Matter and Chemical Bonding

- Review of grade 10 Science
- Measurement and Estimation Lab

Unit 1: Matter, Chemical Trends, and Chemical Bonding

- 1) Review: Matter, Elements, Atomic Structure (Bohr-Rutherford Diagrams), Periodic table of elements

COME
TOGETHER

- 2) Compounds and Bonding (ionic and covalent): naming, structural representation, chemical formula.
- 3) Balancing Equations.

The Basics of Chemistry

- What is matter?
- **Matter:** is anything that occupies space and has a mass (energy is not matter).
- Examples of matter: desk, table, you, me, pencil, water.



Does Homer occupy space? Does homer have a mass?



Does this little pea occupy space? Does it have a mass?

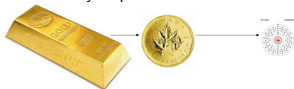


Does water vapour (gas) occupy space? Does it have a mass?



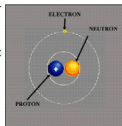
All matter is made of tiny particles called atoms:

- **Atom:** Smallest part of an element that has all the element's properties.
- E.g. Gold (Au) and Silver (Ag) are elements.
- **Elements:** Substance that cannot be broken down into any simpler substance.



Structure of the Atom

- Atoms are **not** the smallest particles of matter.
- Atoms are composed of even smaller particles called **subatomic particles** (the protons, electrons, and neutrons).
- **Electrons:** have a charge of -1. Orbit around the center of the atom in energy levels called shells.
- **Protons:** have a charge of +1. Are located at the center of the atom with the neutrons.
- **Neutrons:** do not have a charge (charge of 0). Are located at the center of the atom with the Protons.

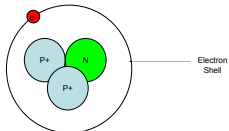


Subatomic Particles

Particle	Symbol	Charge	Relative Mass (u)
Electron	e^-	-1	~ 0
Proton	p^+	+1	1
Neutron	n	0	1



Electrons are in orbit around the nucleus just like planets are in orbit around the sun



Note: The center of the atom is composed of protons and neutrons. The center is called the **nucleus**.

So, how can we tell how many protons, electrons, and neutrons an element has?

•THE PERIODIC TABLE OF ELEMENTS!

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The Periodic Table of Meat

Red Meat Seafood The Noble Meats
 Cold Cuts Poultry Mixed Gamey

10 Cold Meats 11 Beef Cuts 12 Pork 13 Lamb 14 Poultry 15 Fish 16 Eggs 17 Dairy 18 Cheese 19 Nuts 20 Seeds 21 Grains 22 Spices 23 Herbs 24 Fruits 25 Vegetables 26 Mushrooms 27 Condiments 28 Alcohols 29 Beverages 30 Snacks 31 Desserts 32 Sweets 33 Salts 34 Minerals 35 Vitamins 36 Trace Elements 37 Amino Acids 38 Carbohydrates 39 Lipids 40 Proteins 41 Enzymes 42 Antioxidants 43 Phytochemicals 44 Bioactive Compounds 45 Functional Ingredients 46 Food Additives 47 Preservatives 48 Flavorings 49 Colorants 50 Texturizers 51 Emulsifiers 52 Stabilizers 53 Thickening Agents 54 Acidulants 55 Sweeteners 56 Salts 57 Minerals 58 Vitamins 59 Trace Elements 60 Amino Acids 61 Carbohydrates 62 Lipids 63 Proteins 64 Enzymes 65 Antioxidants 66 Phytochemicals 67 Bioactive Compounds 68 Functional Ingredients 69 Food Additives 70 Preservatives 71 Flavorings 72 Colorants 73 Texturizers 74 Emulsifiers 75 Stabilizers 76 Thickening Agents 77 Acidulants 78 Sweeteners 79 Salts 80 Minerals 81 Vitamins 82 Trace 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Trace Elements 1394 Amino Acids 1395 Carbohydrates 1396 Lipids 1397 Proteins 1398 Enzymes 1399 Antioxidants 1400

Metals and Nonmetals

Transition Metals

METALS

NONMETALS

Metals- General properties

- Located on the left hand side
- Usually solids
- Lustrous, ductile, malleable
- Good conductors of heat and electricity

Non-metals: General properties

- Located on the right hand side
- Can be solid, liquid or gaseous
- Dull and brittle solids
- Poor conductors, good insulators

The Periodic Table of Elements: created by Dmitri Mendeleev

- All of the known elements are organized in the periodic table of elements.
- The horizontal rows are called **periods** (7 periods).

PERIODS

1

2

3

4

5

6

The period in which an element belongs tell us how many electron shells that element has!

- Period 1: 1 shell
- Period 2: 2 shells
- Period 3: 3 shells
- Period 4: 4 shells
- Period 5: 5 shells
- Period 6: 6 shells
- Period 7: 7 shells



The Periodic Table of Elements: created by Dmitri Mendeleev

- The vertical columns are called **families** or **groups**. There are 18 groups. Elements in the same family (group) of the periodic table have similar physical and chemical properties.

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

GROUPS

Groups 3 - 12

The Group in which the element belongs tells us the number of valence electrons and the ion that the element will form.

- Group 1 elements: 1 valence electron.
- Group 2 elements: 2 valence electrons.
- Group 3-12 are weird
- Group 13: 3 valence electrons
- Group 14: 4 valence electrons
- Group 15: 5 valence electrons
- Group 16: 6 valence electrons
- Group 17: 7 valence electrons
- Group 18: Complete valence shell (2 for He and 8 for the rest)

Regions of the Periodic Table

Main group or representative elements

- Found in the tallest groups of the periodic table
- Most reactive (except the noble gases) and most predictable in periodic properties

Transition elements

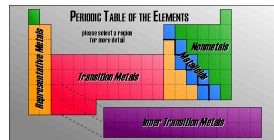
- Found in the middle region of the periodic table in a rectangle
- Composed of metals with less predictable properties with respect to the periodic properties.

Inner transition elements

- Found in the bottom two rows of the periodic table in the lanthanide and actinide series (i.e. atomic numbers from 58 to 72 and from 89 to 104).
- Top row of inner transition elements is also called the lanthanide series, because these elements follow lanthanum, atomic number 57.
- The bottom row of inner transition elements is also called the actinide series, because these elements follow actinium, atomic number 89.

The Categories

- The elements are organized in three categories: the metals (left and centre of the periodic table), the non-metals (on the right side of the periodic table), and the metalloids (the staircase of elements).



Periodic Families

The diagram shows a periodic table with elements color-coded by family. The families are labeled as follows:

- Noble Gas Family** (Yellow): Group 18
- Halogen Family** (Orange): Group 17
- Oxygen Family** (Red): Group 16
- Nitrogen Family** (Purple): Group 15
- Carbon Family** (Blue): Group 14
- Boron Family** (Green): Group 13
- Transition Metals Family** (Grey): Groups 3-10
- Alkali Metal Family** (Light Blue): Group 1
- Alkaline Earth Metals Family** (Dark Blue): Group 2
- Lanthanide Series** (Light Orange): Period 7, Groups 3-10
- Actinide Series** (Light Blue): Period 7, Groups 11-18

The families: Further division of the categories

- Four common Chemical Families:

- 1) **Alkali metals** (group 1): Very reactive metals that react easily with water and oxygen in the air. Hydrogen is not an alkali metal!
- 2) **Alkaline earth metals** (group 2): Less reactive than group 1 metals.
- 3) **Halogens** (group 17): very reactive non-metals.
- 4) **Noble gases** (group 18): non-metals that are very unreactive.



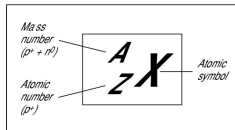
Elements on the Periodic Table

- The **atomic number (Z)** is located on the top left of the square. This number indicates the number of protons in an atom. Since atoms contain the same number of protons and electrons, the atomic number also indicates the number of electrons.
- **Atomic Mass (A):** The number at the bottom of the square indicates the average mass of the atom.
- **Each element on the periodic table is represented by a square.** The square contains a bunch of information about the element.

8 ← ATOMIC NUMBER
 = number of electrons
 = number of protons
 O ← SYMBOL / NAME
 16.00 ← ATOMIC MASS
 = 16 AMU
 (atomic mass units)

Atomic Notation

- A short hand way to represent information of elements from the periodic table.



Elements

- Are pure substances that cannot be separated into different substances by ordinary processes
- Are the building blocks of matter
- All atoms of an element have the same number of protons

18 elements known today

Examples: carbon
nitrogen
gold



Liquid nitrogen

Name the element found in each!



1. Carbon



2. Sodium 2



3. Aluminum



4. Coppers



5. Sulfur



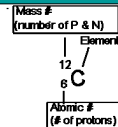
6. Iodine

Symbols of Elements

- Use 1 or 2 letter abbreviations
- Capitalize the first letter only

C	carbon	Co	cobalt
P	phosphorus	Ca	calcium
Ba	barium	Mg	magnesium

Atomic Notation



- Mass # = # Protons + # Neutrons.
- Atomic # = # of protons (also the # of electrons in a neutral atom).

Atomic Notation



- Lithium has 3 electrons.
- Lithium has 3 protons.
- Lithium has 4 neutrons.

More Atomic Symbols



8 p⁺
8 n
8 e⁻



15 p⁺
16 n
15 e⁻



30 p⁺
35 n
30 e⁻

It is the number of subatomic particles that determine what element you have; the atoms of every element have the same number of protons

- Hydrogen atoms always have one proton.
- Lithium atoms always have 3 protons.
- Sample problem: An element has 2 protons. The element is Helium?
- Hint: Listen to me talk...



Calculate # of e, n, p for Ca, Ar, and Br.

RECALL:

protons = # of electrons = atomic number

of neutrons = mass number – atomic number

	Atomic Number(Z)	Mass Number(A)	p ⁺	n ⁰	e ⁻
Ca	20	40	20	20	20
Ar	18	40	18	22	18
Br	35	80	35	45	35

Case Study: Sulfur – A typical atom

- A Bohr diagram:** an illustration of an atom that shows the arrangement and number of electrons in each shell.
- All sulfur atoms have 16 protons.
- All sulfur atoms have 16 electrons (to match the number of protons).



Sulfur

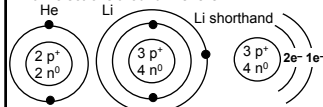
Location of Electrons:

- The electrons are located around the nucleus in shells.
- The first shell (the innermost shell) can hold up to **2 electrons**.
- The next two shells can hold up to **eight electrons** each.
- Valence shell:** The outer most shell of an atom. The electrons in this shell are called the
- valence electrons.** The valence electrons determine the chemical and physical properties of elements.



Bohr - Rutherford diagrams

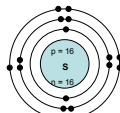
- Putting all this together, we get B-R diagrams
- To draw them you must know the # of protons, neutrons, and electrons (2,8,8,2 filling order)
- Draw protons (p^+), (n^0) in circle (i.e. "nucleus")
- Draw electrons around in shells



Draw Be, B, Al and shorthand diagrams for O, Na

Steps to Drawing a Bohr-Rutherford Diagram – Sulfur 16 electrons, 16 protons, and 16 neutrons

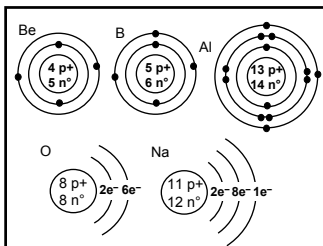
- 1) Draw a small center circle to represent the nucleus.
- 2) Write the number of protons and neutrons within this circle.
- 3) Draw slightly larger circle around this center circle to represent the inner shell.
- 4) Add electrons (2 max) to this shell (represent the electrons as dots).
- 5) Draw slightly larger circle around this circle to represent the next shell.
- 6) Add electrons (8 max) to this shell (represent the electrons as dots).
- 7) If this shell gets filled, draw another shell and add up to 8 electrons to it.



Note: Adding electrons should be done in an organized fashion.

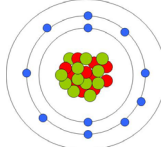
Electron Levels (Shells)

- Contain electrons that are similar in energy and distance from nucleus
- Low energy electrons are closest to the nucleus
- Higher energy electrons are farther away from the nucleus
- The first shell (1) is lowest in energy, 2nd level next and so on 1<2<3<4
- Many shells also have sublevels

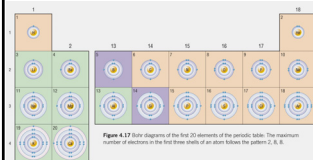


Can you spot the mistake in this Bohr-Rutherford Diagram of Sodium?

- There should be 3 shells, the first with 2 electrons, the second with 8 and the third with 1



Bohr Diagrams of First 20 Elements from the Periodic Table



Periodic Law

All the elements in a group have the same electron configuration in their outermost shells

Example: Group 2
 Be 2, 2
 Mg 2, 8, 2
 Ca 2, 2, 8, 2

Isotopes and Radioisotopes

- Atoms of the same element that have different **numbers of neutrons** are called isotopes.
 - Due to isotopes, mass #s are not round #s.
 - Li (6.9) is made up of both ${}^6\text{Li}$ and ${}^7\text{Li}$.
 - Often, at least one isotope is unstable.
 - It breaks down, releasing radioactivity.
 - These types of isotopes are called radioisotopes
- Q- Sometimes an isotope is written without its atomic number - e.g. ${}^{35}\text{S}$ (or S-35).
- Q- Draw B-R diagrams for the two Li isotopes.
- A- The atomic # of an element doesn't change. Although the number of neutrons can vary, **atoms have definite numbers of protons.**

${}^6\text{Li}$



${}^7\text{Li}$



Lewis Dot Structures of Elements

- When compounds form or when we study the reactivity of elements, the only electrons that are involved are those in each atom's **outermost shell (valence shell)**.
- Lewis Structures** (or electron-dot diagrams): representation of the atom showing the outermost electrons (valence electrons) as dots

Lewis Dot structure for Chlorine:

• Notice that only the valence electrons are represented and the symbol is used to represent the inner electrons and the nucleus!



How to Draw Lewis Dot Structures

- Determine the number of valence electrons of the element.** *Recall: The number of valence electrons (outermost electrons) of an element is equal to its group number.*
- Draw the symbol of the element.** The symbol of the element is used to represent the core (protons and neutrons) and the inner electrons.
- The symbol is assumed to have four sides, and the electrons in the outermost energy level are placed as dots on each of the sides.**
- The electrons are placed singly on each side and are then paired on each side until the number of outer electrons has been attained.**

- In an ionic compound, the charges of the cations and anions must always cancel out.
- Subscripts** are used if more than one atom is needed to cancel the charges:

atoms

ions



sodium fluorine

sodium fluoride

formula

Charge balance: $1+ \quad 1- \quad = 0$

Diatomic Elements

- Some elements are composed of two atoms bonded together
- Whenever you write the symbol for these elements a subscript must be written

- Hydrogen H_2
- Oxygen O_2
- Nitrogen N_2
- Fluorine F_2
- Chlorine Cl_2
- Bromine Br_2
- Iodine I_2

Polyatomic Elements

- Some elements are composed of more than two atoms bonded together
- These elements must also be written with the proper subscript.
- Phosphorus P_4
- Sulfur S_8
- Ozone O_3 (a rare form of oxygen)

Naming Chemical Compounds

- The nomenclature rules proposed by the International Union of Pure and Applied Chemistry (IUPAC) are used as a universal standard method of naming chemicals.
- We will start with two types of compounds:
- An **IONIC COMPOUND** consists of a **metal cation** bonded to a **nonmetal anion**.
- A **MOLECULAR COMPOUND** consists of two nonmetal atoms sharing valence electrons.

Common Names

- A lot of chemicals have common names as well as the proper IUPAC name.
- Chemicals that should always be named by common name and never named by the IUPAC method are:
 - H_2O water, not dihydrogen monoxide
 - NH_3 ammonia, not nitrogen trihydride



Formulas of Ionic Compounds

- The metal cation in many compounds have only ONE possible charge.

Na^+ sodium	Zn^{2+} zinc	Al^{3+} aluminum	Ca^{2+} calcium
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The charges are *memorized* or *predicted* using a periodic table!

- The cations are bonded to nonmetal anions:
- | | | | |
|-------------------|---------------------|-------------------|-------------------|
| O^{2-}
oxide | N^{3-}
nitride | F^-
fluoride | Br^-
bromide |
|-------------------|---------------------|-------------------|-------------------|

Notice that simple anions are always named with the suffix "ide"

Predicting Charges on Monatomic Ions

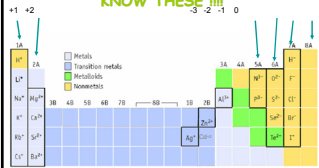


Figure 1. Charges on some common monatomic cations and anions: Metals usually form cations and nonmetals usually form anions.

Forming Binary Ionic Compounds

Write the formula for the ionic compound that will form between Ba^{2+} and Cl^- .

Solution:

- Balance charge with + and - ions
- Write the positive ion of metal first, and the negative ion Ba^{2+} Cl^-
- Write the number of ions needed as subscripts BaCl_2

Writing a Formula

sodium chloride:	Na^+ and $\text{Cl}^- \rightarrow \text{NaCl}$
lithium oxide:	Li^+ and $\text{O}^{2-} \rightarrow \text{Li}_2\text{O}$
aluminum bromide:	Al^{3+} and $\text{Br}^- \rightarrow \text{AlBr}_3$
zinc nitride:	Zn^{2+} and $\text{N}^{3-} \rightarrow \text{Zn}_3\text{N}_2$
potassium iodide:	K^+ and $\text{I}^- \rightarrow \text{KI}$
silver phosphide:	Ag^+ and $\text{P}^{3-} \rightarrow \text{Ag}_3\text{P}$

Formulas of Ionic Compounds

- Many transition metals have more than one possible valence. These elements require Roman numerals because they can have more than one possible charge: anything except Group 1A, 2A, Ag, Zn, Cd, and Al

Multivalent Elements

$\frac{1+2+}{3+6+}$	2+ 3+	2+ 4+	3+ 5+
Cu	Fe	Sn	P
Cr			
Hg	Ni	Pb	As
	Co	Mn	Sb

Rules for Naming Multivalent Compounds

- (1) Write the name of the multivalent metal element;
- (2) write the valence as a Roman numeral;
- (3) write the name of the non-metal with an "-ide" suffix.

FeCl_2	(Fe^{2+})	iron (II) chloride
Fe_2S_3	(Fe^{3+})	iron (III) sulfide
CuCl	(Cu^+)	copper (I) chloride
SnF_4	(Sn^{4+})	tin (IV) fluoride
PbCl_2	(Pb^{2+})	lead (II) chloride

Polyatomic (Complex) Ions

- All of the cations and anions so far have been **simple ions** - single atoms that have lost or gained electrons.
- A **polyatomic ion** is a charged molecule.
examples:
nitrate: NO_3^- sulfate: SO_4^{2-} hydroxide: OH^-
- Most polyatomic ions are anions. Ammonium, NH_4^+ , is the most common complex cation.

Polyatomic Compounds

- Salts can be a combination of a metal with a polyatomic ion.
- Simply treat each polyatomic ion as one unit and cancel charges to obtain the formula:
magnesium sulfate Mg^{2+} SO_4^{2-} MgSO_4
- Add brackets if more than one polyatomic ion is needed:
aluminum carbonate Al^{3+} CO_3^{2-} $\text{Al}_2(\text{CO}_3)_3$
- Add Roman numerals to the name if the metal is multivalent:
iron (II) acetate Fe^{2+} $\text{C}_2\text{H}_3\text{O}_2^-$ $\text{Fe}(\text{C}_2\text{H}_3\text{O}_2)_2$

Polyatomic Compounds

Ca(OH)₂ - calcium hydroxide
CuSO₄ - copper(II) sulfate
NH₄NO₃ - ammonium nitrate
Co₂(CO₃)₃ - cobalt(III) carbonate

The Prefix System for Covalent Compounds

- Covalent compounds are made of two **NONMETAL** elements sharing valence electrons.
- Prefixes** are used to indicate the number of each atom present in the formula.

1	mono
2	di
3	tri
4	tetra
5	penta
6	hexa
7	hepta
8	octa
9	nona
10	deca

Prefix System for Molecular Compounds

- Add prefixes to indicate the number of atoms.
- Omit 'mono-' prefix on the first element.
- Change the ending of the second element to '-ide'.

CO₂ is named "carbon dioxide"

CO is named “carbon monoxide”

N_2O is named "dinitrogen monoxide"

SO_3 is named "sulfur trioxide"

Challenge: SO_3^{2-} is named **sulfite**

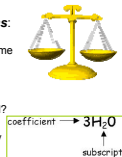
Balancing Equations

- **Law of Conservation of Matter:**
 - In a chemical reaction, matter can be neither created nor destroyed.
 - In a chemical reaction, the amount of reactants equal the amount of products.



Balancing Equations

- Paraphrase:
- Law of Conservation of **Atoms**:
 - The number of atoms of each type of element must be the same on each side of the equation.
- If the subscripts cannot be altered, how can the atoms be made equal?
- Adjust the number of molecules by changing the **coefficients**.



How molecules are symbolized



- Molecules may also have brackets to indicate numbers of atoms. E.g. $\text{Ca}(\text{OH})_2$
- Notice that the OH is a group
- The 2 refers to both H and O
- How many of each atom are in the following?
 - a) NaOH Na = 1, O = 1, H = 1
 - b) $\text{Ca}(\text{OH})_2$ Ca = 1, O = 2, H = 2
 - c) $3\text{Ca}(\text{OH})_2$ Ca = 3, O = 6, H = 6



Balancing equations: MgO

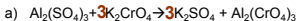
- Example: Magnesium + Oxygen (from lab)
- $\text{Mg} + \text{O}_2 \rightarrow \text{MgO}$



- However, this is not balanced
- Left: Mg = 1, O = 2
- Right: Mg = 1, O = 1

Some Practice Reactions

1) Balance the reactions:



Balance equations by "inspection"

From $\text{Mg} + \text{O}_2 \rightarrow \text{MgO}$
 $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$ is correct
 $\text{Mg} + \frac{1}{2}\text{O}_2 \rightarrow \text{MgO}$ is incorrect
 $\text{Mg}_2 + \text{O}_2 \rightarrow 2\text{MgO}$ is incorrect
 $4\text{Mg} + 2\text{O}_2 \rightarrow 4\text{MgO}$ is incorrect

Hints: start with elements that occur in one compound on each side. Treat polyatomic ions that repeat as if they were a single entity.

- a) $\text{P}_4 + 5\text{O}_2 \rightarrow \text{P}_4\text{O}_{10}$
 b) $2\text{Li} + 2\text{H}_2\text{O} \rightarrow \text{H}_2 + 2\text{LiOH}$
 c) $2\text{Bi}(\text{NO}_3)_3 + 3\text{K}_2\text{S} \rightarrow \text{Bi}_2\text{S}_3 + 6\text{KNO}_3$
 d) $\text{C}_2\text{H}_6 + 3.5\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$
 $2\text{C}_2\text{H}_6 + 7\text{O}_2 \rightarrow 4\text{CO}_2 + 6\text{H}_2\text{O}$

Other Balancing Hints

- Balance the metals first.
- Balance the ion groups next.
- Balance the other atoms.
- Save the non ion group oxygen and hydrogen until the end.

Homework:

- Complete Balancing Handout
- Naming Compounds Exercise Handout

Balance these skeleton equations:

- a) $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$
 b) $3\text{Ca} + \text{N}_2 \rightarrow \text{Ca}_3\text{N}_2$
 c) $\text{NH}_4\text{NO}_3 \rightarrow \text{N}_2\text{O} + 2\text{H}_2\text{O}$
 d) $2\text{BiCl}_3 + 3\text{H}_2\text{S} \rightarrow \text{Bi}_2\text{S}_3 + 6\text{HCl}$
 e) $2\text{C}_4\text{H}_{10} + 13\text{O}_2 \rightarrow 8\text{CO}_2 + 10\text{H}_2\text{O}$
 f) $6\text{O}_2 + \text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$
 g) $3\text{NO}_2 + \text{H}_2\text{O} \rightarrow 2\text{HNO}_3 + \text{NO}$
 h) $\text{Cr}_2(\text{SO}_4)_3 + 6\text{NaOH} \rightarrow 2\text{Cr}(\text{OH})_3 + 3\text{Na}_2\text{SO}_4$
 i) $\text{Al}_4\text{C}_3 + 12\text{H}_2\text{O} \rightarrow 3\text{CH}_4 + 4\text{Al}(\text{OH})_3$